

ED 021 531

JC 680 270

CONFERENCE ON CHEMICAL TECHNICIANS. CURRICULUM DEVELOPMENT AND STUDENT RECRUITMENT (NEW YORK CITY COMMUNITY COLLEGE, OCTOBER 27-28, 1967).

Pub Date 67

Note- 55p.

EDRS Price MF-\$0.25 HC-\$2.28

Descriptors- *CHEMICAL TECHNICIANS, COLLEGE ADMISSION, *COLLEGE STUDENTS, CONFERENCE REPORTS, CURRICULUM DEVELOPMENT, CURRICULUM PLANNING, *JUNIOR COLLEGES, *RECRUITMENT, *TECHNICAL EDUCATION

This report presents major statements related to curriculum development or student recruitment in chemical technology. The USOE's suggested 2-year post-secondary curriculum in chemical technology was described by Walter Brooking. In reporting the American Chemical Society's (ACS) recommendations for the chemistry core content of a chemical technology program, Carlton Roberts noted problems of immediate concern. William Samuels, Jr., commented on the implications of the foregoing curriculums on the use of technicians in industry. Following Donald Swanson's treatment of the relationship of the scientific assistant to the professional scientist, William Forter discussed the chemistry student and the chemical technology curriculum. Suggesting materials needed for the fulfillment of the ACS guidelines was the purpose of Howard Ayer's presentation. Three topics were discussed in a round table conference: (1) the technician in college, (2) the technician in industry, and (3) the college/industry interface. William Thrane then cited the need for greater dissemination of materials in an effort to recruit more and better students in the field. A talk on the subject of a public community college's approach to the recruitment problem was delivered by Camelo Greco followed by a panel discussion of the recruiting problem from other vantage points. (DG)

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CONFERENCE ON CHEMICAL TECHNICIANS
CURRICULUM DEVELOPMENT
& STUDENT RECRUITMENT

October 27-28, 1967

Host

New York City Community College

Co-Sponsors

American Chemical Society

Office of Education

ED021632

U.S. DEPT. OF HEALTH, EDUCATION & WELFARE
WASHINGTON, D.C. 20540

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Introduction

The Conference on Chemical Technicians--Curriculum Development and Student Recruitment was conceived at a meeting of staff members of the American Chemical Society and the U. S. Office of Education, Division of Vocational and Technical Education. The subject of the meeting was the correlation of recommendations made for chemical technology education by the ad hoc ACS Technician Curriculum Committee (1967) and the U.S. Office of Education (1964). The ACS committee's recommendations dealt with the chemistry core content of the curriculum. The U. S. Office of Education's recommendations dealt with the total curriculum content and facilities.

In the early planning of the conference, it was decided that the critical problem of student recruitment should receive attention, as well as the curriculum in which students would matriculate. It was also felt that more could be accomplished if the number of attendees was limited so that more discussion could be encouraged. The success of the round table and panel discussions was due to the participation of the attendees.

It is expected that this conference will serve as a precedent for holding similar conferences in other regions of the country.

Kenneth M. Chapman

Acknowledgments

The American Chemical Society and the U. S. Office of Education, Division of Vocational and Technical Education, wish to express their sincere appreciation to Mr. Milton Bassin, president, New York City Community College, for making his institution's facilities available for the meeting. A large part of the success of the meeting was due to the excellent cooperation of the staff of the New York City Community College, and particularly to Mr. Fred Schmitz, chairman, Department of Chemical Technology.

An expression of appreciation is richly deserved by the colleges and companies who supported the attendance of their representatives. Most importantly, we wish to say "Thank you" to each of the attendees, for each one contributed to the conference, especially those who accepted formal responsibilities in the meeting. Since their contributions are not specifically acknowledged in these Proceedings, we wish to thank especially the following for giving critiques of the papers presented: William Pfister, Farmingdale Agricultural and Technical College; Anne Wagner, Onondaga Community College; Samuel Ellis, Dutchess Community College; and John Tyler, Jr., Holyoke Community College. We also wish to thank Charles Haas, The Pennsylvania State University, for his concluding remarks for the conference.

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U. S. Office of Education Development of
Chemical Technology
A Suggested 2-Year Post-High School Curriculum

by

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U. S. Office of Education
Washington, D.C.

The U. S. Office of Education is glad to be a co-sponsor of this conference. The Office has been and is deeply interested in programs to educate chemical technicians. In order to help to promote chemical technology programs the Office of Education started to develop a curriculum guide in chemical technology in 1960. It was published in 1964.

The guide was developed as a curriculum plan which reflected exemplary chemical technician education programs. It is used as a guide by school administrators and their advisors and faculty in planning, developing, or improving chemical technician education programs in their institutions. It is intended to be a plan which serves as a pattern to be modified by the school as seems appropriate in light of employer and other advisory group recommendations to provide the program best suited to the needs of the area or region.

It was developed from materials provided by contracts with the Connecticut State Department of Education and with Erie County Technical Institute. Strong advisory committee assistance was provided throughout the contract programs; and the final review draft was reviewed widely by employers, knowledgeable educators, and representatives of the major related technical societies, including the American Chemical Society and the Manufacturing Chemists Association.

It contains an outline for a two-year four-semester curriculum. It provides a general outline for each course in the curriculum, laboratory and facility layouts, lists of equipment for laboratories and student lockers, textbooks, and references supporting each course. Special attention is given to laboratory facilities because of the need for control of chemical fumes and solutions and the need for careful planning of chemical teaching facilities and the costs. Library facilities, content, organization, staff, and use were emphasized.

The indicated level of instruction is for a rigorous post-high school program, but the sequence of course work may start at any grade level where students have the prerequisite background and understanding.

Upon publication in 1964 it was distributed to the state directors of vocational and technical education, state supervisors of technical education, and several hundred interested institutions. It was reprinted in 1967 to meet the constant demand for it as a guide.

We believe the chemistry core curriculum materials developed by the Technician Curriculum Committee of the American Chemical Society are a very important contribution to the education of chemical technicians. The curriculum bears a special relationship to the U. S. Office of Education's curriculum and other chemical technician programs already in operation. Department heads and instructors can use the core materials (which are presented in topical outline but not separated into courses) as a guide to examine the various courses in their program and decide where best to incorporate the core content. Much will already be included. Some will want to reorient and reorganize some of their courses to provide a new and more effective approach to presenting parts of their program.

The American Chemical Society chemical core curriculum materials do not cover the content of technical specialty courses such as "unit operations," which are so important in educating technicians. These may be found in existing guides such as the U. S. Office of Education chemical technology curriculum, and in existing programs. They must constantly be refined by the heads of programs with outside advisory committee assistance to keep them up to date.

We hope that exemplary programs demonstrating the use of all of the American Chemical Society's committee's core materials can be found in the relatively near future. These can provide a basis for updating the U. S. Office of Education chemical technology guide.

Development by the American Chemical Society
Ad Hoc Technician Curriculum Committee
of Recommendations for the Chemistry Core Content
of a Chemical Technology Program

by

Carleton W. Roberts
The Dow Chemical Company
Midland, Michigan

I have the privilege this morning of presenting to you the results of the labors of many people. The reprint that you have before you with the covering items should be reasonably self-explanatory. I would like to give you a little historical background as to the development of this curriculum. I would also like to give you some idea of where the ACS stands now in its relationship to the chemical technician.

The ACS has held biennial educational conferences. These conferences cover the whole range of chemical education and the relationship that our Society has with the academic fraternity responsible for the formal education of chemists. In addition, of course, the teaching of chemistry at high schools and beyond must be an important consideration. In the conference held in May of 1964 the problem was posed as to what the Society could or should do in the training of chemical technicians. This was an outgrowth of the Society's long-range interest in the two-year college chemistry programs. At that time it was apparent that there was a real challenge to the Society to investigate the entire relationship that the Society should have with the training, the use, and the acknowledgment of the existence of the chemical technician.

As a result of this meeting a Board committee was formed under the direction of Dr. William G. Young. This committee put together a very definitive report covering all of the aspects of two-year college chemistry training, especially as it applied to the chemical technician. Among the several recommendations the two most important ones led to the formation of a subsequent ad hoc Board Committee on Technician Curriculum and then to a committee of the Council under the chairmanship of Roy Clemence of Abbott Laboratories to study the area of affiliation of the chemical technician with the ACS. Both of these committees have continued to act.

The Young committee had set out the number of credits relative to the total technician training program that was the chemistry core. It was a responsibility of our second ad hoc

Board committee to develop the core curriculum in detail. At the same time that the Technician Curriculum Committee was formed it was still the consensus that the training should involve so-called transfer courses in chemistry.

During the organizational stage of this second committee it was finally decided that it was impossible to devise an educational program for the training of chemical technicians that served at the same time the full transfer requirements to a four-year school for the training of chemistry majors. This did not imply, as far as we were concerned, that there was any great difference in course content or that there was necessarily any great difference in the level at which particular subject matter was treated. We were convinced that the in-depth transfer treatment of all of the subject matter could not possibly be handled in the training of chemical technicians without the loss of one of the major portions of the training programs--the laboratory experience. The committee and I believed that if we were to do justice to a curriculum for the training of chemical technicians, we would have to emphasize above all else the laboratory experience.

With this in mind we have put together what we believe to be a reasonably definitive list of topics that can and should be covered in a two-year technician training program. In addition, we have put together what we believe to be a reasonable grouping of courses to be spread over two years.

Now you can see that the terms that are used to describe the topical portions of the course are exactly those that are used to describe the topics in a four-year or even a graduate or post-Ph.D. experience at the formal educational institution. This is unfortunate, but the semantics of the problem are such that it would be impossible to devise an entirely new vocabulary to describe the topics we believe should be covered in varying depths and to varying degrees in the technician training program. There has been considerable criticism of this particular aspect of our curriculum, and I think with some justification. The justification is especially true when, in further discussion with the people who have been most critical, it is apparent that the real problem resides in the failure to be able to read the introductory material to this portion of our report. This is not to say that there are not some real associated problems with putting such a topical outline into practice.

There are three major problems of immediate concern:

1. There are no textbooks readily available at the present time that would permit the presentation of this type of integrated program without a tremendous amount of additional preparatory work by both the students and the instructor. This we fully recognize. Along with a number of other problems and challenges in the whole technician area, the Society, through

our committee and through other committees, is continuing to investigate ways in which this and other problems and challenges can be met. Perhaps today is one of those discussions and workshop operations that will permit us to agree on ways to find solutions to some of these problems.

2. The second major obstacle to the national acceptance and use of such a topical outline and of the suggested course structure is the lack of adequate teaching personnel. It is fairly obvious that there are not that many good teachers in chemistry who can handle such a curriculum alone without the benefit of either time to prepare proper lecture and text material or the availability of texts already in print.

3. The third major problem is the attraction of enough acceptable students to give stature and national status to the programs in force today, much less what we have tried to foresee for the future.

I am sure we will cover many more problems, and I hope we can rebut and/or agree with all of the constructive suggestions in the area of the core curriculum during our meeting. I would suggest that you look at these items through technician-training glasses rather than Ph.D.-training glasses.

In closing, I would like to indicate that the Technician Curriculum Committee is continuing to devise ways in which ACS can implement the curriculum guidelines. The implementation ranges from career booklets to attract students to careers in chemical technology to counseling booklets for counselors in high schools and colleges. The chemical industry sadly and sorely needs a good supply of properly trained chemical technicians. Perhaps from the meetings today and tomorrow we can find additional ways in which both the attraction and training of students in these curricula can be implemented.

Implications of Curriculum on Technician Utilization in Industry

by

William P. Samuels, Jr.
Union Carbide Corporation
Chemicals and Plastics
Bound Brook, New Jersey

When I first learned of the opportunity to participate in this conference, my reaction was one of delight. After some reflection on my participation, my reaction was one of humility and a little bit of awe along with delight. Delight because the subject of our conference--Chemical Technicians--is of considerable interest to me. Some humility and awe because the two curricula we have heard about this morning--one from the HEW Office of Education and the other from the ACS ad hoc Technician Curriculum Committee--are the distilled thoughts of two distinguished groups of individuals representing education, government, and industry. My purpose is to comment on the implications of these curricula on the use of technicians in industry--basically to criticize them.

In approaching this critique I think it is essential to discuss several broad guidelines or criteria that are important in defining and developing these curricula. Guidelines that I would include are the following:

1. The curriculum should provide a fundamental background--the so-called core subjects--in today's chemistry, with special attention to organic and polymer chemistry, basic physics, and mathematics through algebra. It is essential to build a solid foundation for the continual assimilation of new know-how later. In the resolution of any time-pressure problems, basics should prevail at the expense of specifics. For example, the chemistry of condensation polymers would prevail over the chemistry of polyesters.

2. The curriculum should emphasize laboratory techniques, skills, and experiments instead of theoretical concepts. Today--and with the increasing complexity of our technology it will be ever true--the value of the chemical technician lies in his ability to reduce ideas to practice. His value stems from his expertise in setting up and conducting experiments. On the other hand, his value does not arise primarily from his ability to think analytically and conceptually although the opportunity to do so is clearly available. Basically, he is a doer rather than a thinker--a doer who is an invaluable part of the team necessary to translate an interesting discovery into a practical reality with value to society.

3. The program should be realistic in its entrance requirements and in the scope, sophistication, and difficulty of its course content. Any thoughtfully conceived program will obviously provide ample employment opportunities in industry for its graduates. The question is, however, whether it will

solve industry's critical need for technicians. To do so it is clear that an entirely new segment of the manpower market must be tapped. It also seems clear that entrance requirements for many two-year programs are not different from four-year baccalaureate programs. These statements are antithetic. To solve one of the problems associated with chemical technicians we must tap a new manpower market from the large percentage of high school graduates who do not enter college and who do not meet the requirements for a four-year baccalaureate program. I recently attended a symposium on chemical technicians, the purpose of which was to acquaint high school guidance counselors with this career. One of their major questions--their major criticisms of chemical technician programs--related to entrance requirements and mathematics requirements. The guidance counselors submit that these requirements are unrealistically high. I concur.

4. Another point related to the aforementioned is the overriding objective of the program. Should the curriculum be of the so-called transfer type? Should the curriculum be of the so-called career type? Should the curriculum be a compromise of these objectives? More and more I take the view that the curriculum should be entirely career oriented, a meat and potatoes curriculum with no hors d'oeuvres or desserts. If we are going to train chemical technicians, let us do it and do it well. Let us not train one-half a B.S.

5. As a consequence of this career objective, the program should either offer cooperative experience in industry during the regular semester or (at the very least) develop means for experience during the summer. With the definite career orientation, I think it even makes sense to have the program be continuous work/study, one with no traditional summer vacation period. By doing so, we might require less than two years to train a technician effectively, and the shorter time period would help tap a new segment of the manpower market.

6. The curriculum should be flexible to provide for changing emphasis and trends in chemistry and to recognize the needs of the community manpower market, which will be the primary user of its products.

7. The curriculum should attempt to anticipate the future needs of the chemical industry five, ten, and even fifteen years from now. It seems to me that it will not be too long before laboratories are staffed entirely by Ph.D.'s and chemical technicians, with the formers' responsibility to conceive and the latters' responsibility to implement ideas.

Of the two curricula under discussion I have a definite preference, and in fact much enthusiasm, for the one developed by the ACS ad hoc committee. It has a modern approach. It emphasizes basic concepts and is devoid of frills. It recognizes the need for the development of experimental talents. My only reservation (and this presents a moot question for discussion) is that this curriculum is too sophisticated and has unrealistically high requirements. Although it certainly possesses attractive features, the U. S. Office of Education curriculum seems not sufficiently modern. Its course titles and course content are reminiscent of ten to twenty years ago. Furthermore,

I am not sympathetic to the inclusion of courses like General and Industrial Economics and Industrial Organizations and Institutions.

In conclusion, there is a compelling need for chemical technicians throughout the country. The opportunities for them during their career with regard to intellectual recognition and financial rewards, as well as the opportunities to move to areas other than R & D--such as production, engineering, sales, marketing, industrial relations--are indeed varied and substantial.

Notwithstanding the compelling need and attractive opportunities, we are not attracting sufficient numbers of young men and women to chemical technician careers. To do so we must do several things. We must tap a totally new segment of the manpower market; we must give to high school students and parents information on attractions and rewards of the career; we must increase communication between two-year college personnel, high school guidance counselors and chemistry teachers, and industrial representatives in order to solve mutual problems; and we must define realistic entrance requirements and curricula. Your presence here is indicative of the swelling interest in this career and in solving problems associated with it. With continued interaction like this meeting we will surely solve the problems.

The Relationship of the Scientific Assistant to the Professional Scientist

by

**Donald L. Swanson
American Cyanamid Company
Stamford, Connecticut**

At Cyanamid's Stamford Research Laboratories we have about 125 technicians supporting about 300 professional scientists (exclusive of the management group). The total population, including craftsmen, secretaries, and so on, is about 850. The roles played by these technicians, or scientific assistants as we call them, vary greatly within the laboratories, but I can make some generalizations and will illustrate these with descriptions of assignments given a few of our scientific assistants.

Although our company and most others refer to anyone with a baccalaureate or higher degree as a "professional," the new B.S. does not move directly into a truly independent role. His initial assignment may be somewhat subordinate and not too different from that of a scientific assistant. A research manager, realizing that one of his scientists requires assistance in conducting his experiments, must decide whether he should hire a high school graduate, a college dropout, an A.A.S., or a B.S., assuming all types are available.

The choice certainly depends upon the task at hand. For very routine measurements one might select a high school graduate, for example. However, I submit that the preferred training for an assistant in our laboratory is the A.A.S. degree. This statement not only is appropriate since the A.A.S. degree holder is the central figure in this conference, but is substantiated by the consistent agreement among the number of people responsible for management of research programs in the laboratory with whom I discussed this subject.

What is it in the background of the A.A.S. that makes him so desirable? In Figure 1 (p. 10), we see that contrasted with a high school graduate, the A.A.S. has considerably more chemistry, physics, and mathematics. In addition, the A.A.S. has survived an intellectual screening process in getting his degree and can be expected to be more intelligent. Because he has completed a science curriculum, we can be more certain he is motivated to work at science. Because a high school graduate is so limited, most of our research managers will consider only persons with education beyond high school for their scientific assistant jobs.

In comparison with a person who has dropped out of a four-year program in chemistry, the A.A.S. normally has had more science, and what he has had was certainly aimed toward more

Figure 1

COMPARISONS OF KNOWLEDGE AND SKILLS

THE AAS:

...HAS HAD MORE CHEMISTRY, PHYSICS,
MATHEMATICS

...IS MORE INTELLIGENT

...IS MORE MOTIVATED

...HAS HAD MORE PRACTICAL SCIENCE

...IS EXPERIENCED IN THE LABORATORY

...IS SUCCESSFUL

...HAS BEEN TRAINED IN PRACTICAL

LABORATORY WORK

...HAS A GREATER INTEREST IN GETTING
DATA

HIGH SCHOOL
GRAD.

COLLEGE
DROP-OUT

BS

AAS

practical aspects. An A.A.S. will have had more work-oriented laboratory experience than even a person completing a modern B.S. program in almost any college or university. Perhaps the greatest advantage an A.A.S. has over a college dropout is that he has achieved what he set out to do while the dropout failed, for whatever reason. The A.A.S. will expect to continue to be successful in his job, and this psychological edge should give him more drive and ambition.

To support a scientist, some managers actually prefer an A.A.S. to a B.S. and give two reasons for this preference: (1) The A.A.S. had had a greater training in practical laboratory work than the B.S., who has had more theoretical and esoteric courses. (2) The A.A.S. is interested in laboratory work, for example, in getting data for an end in itself, whereas many of those with the B.S. degree consider the laboratory as a stepping stone to some more appropriate job in sales, manufacturing, and so forth. Of course, no small part of the problem is that a person really interested in research as a career rarely stops at the B.S., but goes directly on to graduate school. It is also true that the A.A.S. may, in time, want more education in order to progress. However, what I am talking about is finding a man to fill an opening, to pull his load with a minimum of training, and to continue to be motivated and productive as he gains experience. The A.A.S. has proved to be a very satisfactory background for this supporting role.

Now let me turn to my assignment of describing the relationship of the scientific assistant to the professional. I will illustrate the role of the scientific assistant by describing the jobs of some of our A.A.S. degree holders. The professional scientist to be discussed will be a Ph.D. or equivalent. Both the scientific assistant and the professional scientist are members of the team. On the diamond only one player pitches, one catches, one plays first base, and so on. Some are stars and receive more pay. Certainly the A.A.S. is not paid as much as the Ph.D., but he does start at over \$6,000 a year, and his salary increases with experience and know-how. More about this later. Our scientific assistant is the data collector, the doer of experiments. He soon becomes an expert in a small area so that no one needs to tell him how to go about a task. To use the baseball analogy, he may be told to hit, to take, or to bunt; but he is not told how to stand or to hold the bat. He is completely familiar with his instrument or whatever his role is. He is an essential member of the research team.

Specifically what are our A.A.S. people doing? A number of them are in the analytical department with which I am associated. In Figure 2 (p. 12), I indicate that these scientific assistants operate gas chromatographs, spectrometers, and thermal analysis equipment. One of them does essentially all of our microanalysis. They not only prepare the samples and collect the data but do some interpretation as well. They are capable of recognizing good data and frequently can diagnose the cause

Figure 2

EXAMPLES OF SCIENTIFIC ASSISTANT TASKS

OPERATE GAS CHROMATOGRAPH

OPERATE UV SPECTROPHOTOMETER

PERFORM THERMAL ANALYSIS

PERFORM MICROANALYSIS

OPERATE MICROREACTOR

SYNTHESIZE INORGANIC COMPOUNDS

EVALUATE SURFACE COATINGS

EVALUATE POLYMER SYSTEMS

of spurious data. In many cases they perform minor maintenance on their instruments. In the analytical area, they are assigned somewhat less complex analyses than professionals. Thus, in our department the A.A.S. is usually a co-worker with the professional rather than an assistant.

In any other area of our laboratory the A.A.S. has an equally challenging assignment. One assistant is in charge of maintaining and operating a microreactor under a variety of conditions for the evaluation of catalysts. Another has become skilled in the field of inorganic synthesis. Another runs through an exhaustive list of tests in the evaluation of surface coatings. Still another develops means of polymerizing and evaluating new polymer systems. In each case a scientist sets the general priority of work and makes the decisions based on the results as his part in the team effort. In each case the assistant is given some responsibility, and he is evaluated on what he makes of that responsibility. When discussing the role of the A.A.S. in no case did I hear the phrase "pair of hands," which is sometimes attributed to technicians. Obviously, he is much more than that.

The scientist who has an assistant assigned to help him with his work frequently considers that he has gained status. The scientist may interpret the assignment of an assistant to him as meaning he is so important he needs help rather than that the project is so important he needs help. The motivation of the scientist usually improves. In turn the scientist takes such an interest in the assistant that he trains him in

technique and tutors him in the areas of his (the scientist's) knowledge.

However, because of the shortage of assistants, the scientist usually has to request the use of one of the assistants assigned to the group of which he is a member. Even here, there develops a strong bond among all group members, the assistants being given the opportunity to learn through the scientist's experience.

In the top drawing of Figure 3 (p. 14), I show that our research groups are populated with a low ratio of support personnel to professionals. However, all the research managers I talked with wished for a higher ratio. The ideal ratios cited ranged from about one-to-one up to three-to-one. In the lower picture a happy scientist has two assistants. Remember, I am speaking of research groups where nothing is routine. This high ratio puts demands on both the scientist and the assistants. The former must generate enough ideas to keep one to three assistants busy evaluating them. The assistants must be very capable and independent in the laboratory. To reemphasize, the scientific assistant is a scarce commodity highly sought after.

Let me return to the growth potential of the A.A.S. that I referred to previously. As I said, starting salaries passed the \$6,000-a-year level a year or two ago. Figure 4 (p. 15), shows that the starting salary range for an A.A.S. is much closer to that for the B.S. than that for a high school graduate. In fact, the B.S. and A.A.S. ranges nearly touch. Although not shown here, a college dropout has a broad range of starting salaries, extending from that of the high school graduate, if he has completed less than one year, to that of the A.A.S., if he has completed three or more years.

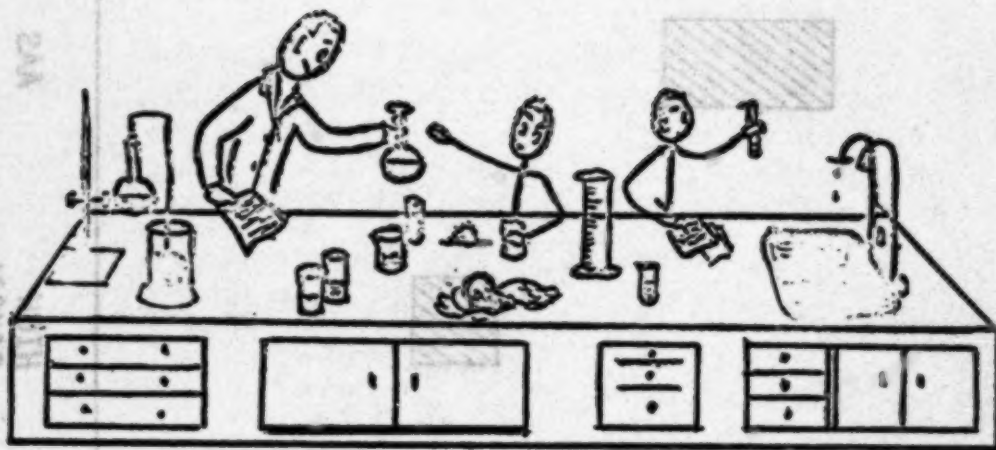
Our company and others review these salaries annually and make sure outstanding performance is rewarded. Cyanamid has a method of evaluating the work a man is doing on the basis of two factors: first, the knowledge and skills the man brings to the job; second, the task he performs. The knowledge and skills factor is augmented by formal courses or work experience. The tasks factor is increased when the man is offered and accepts greater responsibility. As these factors of knowledge and skills and tasks for a man increase, he will be able to climb the ladder shown in Figure 5 (p. 16) to assistant scientist and eventually to associate scientist. These are positions non-exempt from the federal Wage and Hour Law. Finally, he may be promoted to the professional or exempt ranks, in every way equivalent in privileges and responsibilities, to B.S., M.S., or Ph.D. degree holders.

For orientation, the scientist's level is populated by new B.S. and M.S. graduates; the research scientist's level by new Ph.D.'s or equivalents; and the senior research scientists

Figure 3



Present



Ideal

Figure 4

STARTING SALARIES P.L.D. (1967)

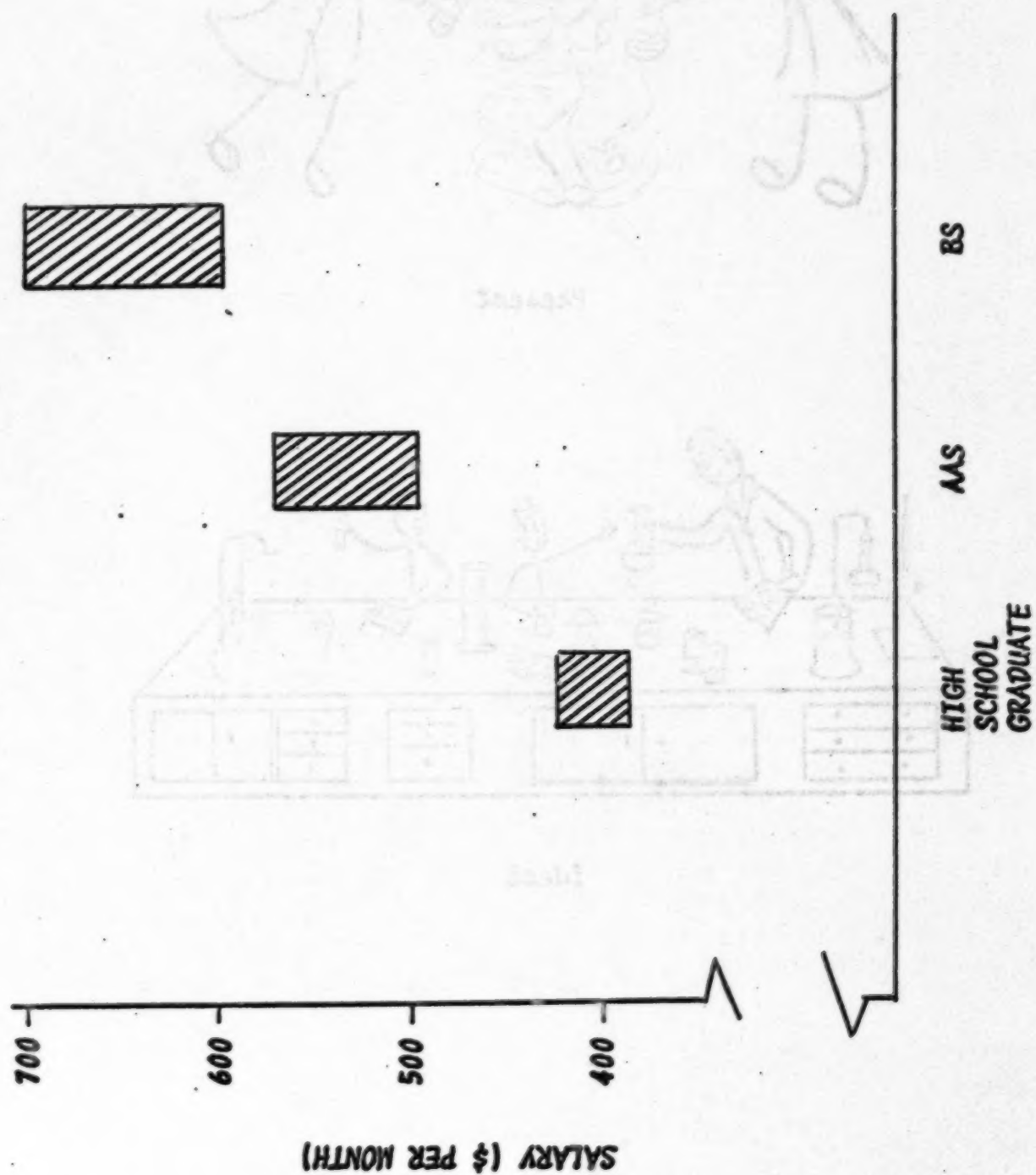
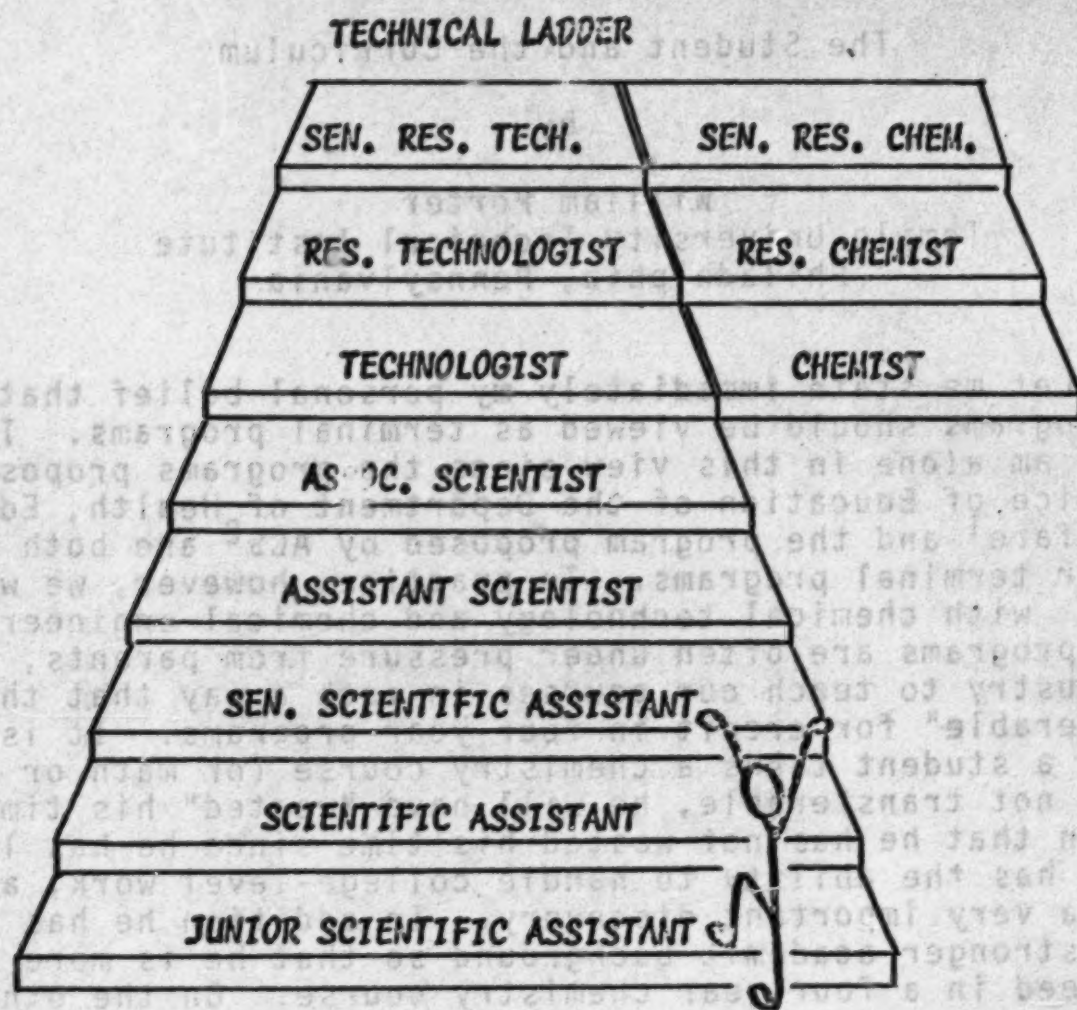


Figure 5



by our more senior staff. No table of organization limits the number of people that can be thus promoted, only each man's merits. This progression to higher levels can be speeded by course work, particularly when it leads to degrees; but course work or degrees are not necessary if the man is capable of assuming more responsibility.

Some may say that the desire to advance from the supporting role to that of a professional scientist means that our company does not provide a career opportunity for the technician. I would say that nothing is further from the truth: the individual is given the opportunity to accept responsibility, and what he does thereafter depends upon his ability and his ambition. One of our truly outstanding technicians likes nothing better than to keep busy morning to night turning out as much data as any three other men, without the slightest desire to know the implications of the data. Another technician wanted to get into sales and after a few years in the laboratory was transferred to the sales force. This created still one more opening for a scientific assistant. Know anyone getting an A.A.S. at the end of the first semester?

I really did not come to this conference to try to fill this or any other specific opening. I do hope I did succeed in showing how we view the relationship between the scientific assistant and the professional scientist.

The Student and the Curriculum

by

William Porter
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Let me state immediately my personal belief that two-year programs should be viewed as terminal programs. I don't think I am alone in this view since the programs proposed by the Office of Education of the Department of Health, Education and Welfare¹ and the program proposed by ACS² are both basically two-year terminal programs. In practice, however, we who are working with chemical technology and chemical engineering technology programs are often under pressure from parents, students, and industry to teach our courses in such a way that they are "transferable" for credit in four-year programs. It is argued that if a student takes a chemistry course (or math or physics) that is not transferable, he will have "wasted" his time. I maintain that he has not wasted his time since he has learned that he has the ability to handle college-level work, and this may be a very important discovery. In addition he has acquired a much stronger academic background so that he is more likely to succeed in a four-year chemistry course. On the other hand, if we try to present courses for chemical technology students at a level that will make the courses acceptable for transfer credit in a four-year curriculum, we run the risk of failing the student who should be benefiting from a two-year terminal program.

Who are the students who should be in a two-year program? A paper prepared by Fred C. Dietz of Merritt College reported that students in Merritt's two-year program came primarily from pretechnical programs in high schools, referral by counselors, and as transfers from four-year programs. He pointed out that referral by counselors had not been a very good source of students, since many counselors would forget that the program existed. He also felt that it was desirable to build a greater social status for technologists in order to attract more students.³ In a critique of Dietz's paper by Robert D. Fellman, one point made was that the "status would not be enhanced by encouraging chemistry dropouts to enroll in a general program in chemical

¹Office of Education, U. S. Dept. of Health, Education and Welfare, Chemical Technology--A Suggested 2-Year Post High School Curriculum, Technical Education Program Series No. 5.

²"Chemistry Core Outlined for Technicians," Chem. & Eng. News, May 22, 1967, pp. 46-51.

³Fred C. Dietz, "Problems of a Junior College Having Two Chemistry Programs," Advisory Council on College Chemistry, Problems in College Chemistry--Supplement, Publication No. 20A.

technology. The implication that technicians or prospective technicians are much different in general ability from the prospective transfer students cannot be justified."⁴

In the same report, Fred W. Schmitz⁵ states some of the important problems encountered in recruiting students for chemical technology programs, which include unrealistic evaluation of abilities by students and parents, inadequate high school counseling and lack of knowledge of the chemical technology field. He reports that most junior college applicants in New York State come from the middle two quarters of their high school class. The students are generally less motivated, come from a lower economic background, have poorer high school records and poorer work-study habits than those of four-year program entrants. He also reports that the attrition rate is high, with only 35 per cent of the students entering the program finishing it in two to three years.

Our experience in the three-year Chemical Engineering Technology Program at Temple University has been similar to that reported by Mr. Schmitz. In general, less than half the entering freshmen will finish the three-year course. In most cases, our failures seem to be due to poor motivation and poor work habits rather than lack of native mental ability.

Yet despite the observed shortcomings of these students, I believe that we must look to the middle two quarters of the high school class to produce students for the chemical technology program. This means that our programs must be tailored to the needs of this student. This is not to say that it will be a trivial, low-level program; but it will allow for the fact that the students do not have a strong academic orientation. There will be students who transfer to the chemical technology program from four-year chemistry and engineering programs, but I doubt if there are enough students of this type to justify the operation of many two-year programs.

A certain number of students will enter the chemical technology program because they have developed an interest in chemistry as a hobby. They may have a home laboratory or have had some opportunity to work in a laboratory. However, their interest may be primarily in the manipulation of laboratory equipment, not in chemical theory. This type of person should make a

⁴Robert D. Fellman, "Critique of F. C. Dietz's Paper," Advisory Council on College Chemistry, Problems in College Chemistry--Supplement, Publication No. 20A.

⁵Fred W. Schmitz, "Problems of the 2-Year College with a Career Curriculum," Advisory Council on College Chemistry, Problems in College Chemistry--Supplement, Publication No. 20A.

good student in a two-year program. In many cases, however, he will fail in non-laboratory subjects and perhaps even in the theory and calculation portions of his chemistry classes.

Many of the students will enter a two-year program because they think they ought to have some post-high school training. After all, education is very stylish these days, and a few years of post-high school work may serve as a ticket of admission to a better job. They may enter a chemical program because they liked math and science in high school, or simply because they saw some interesting Du Pont advertisements on television.. In other words, these students have a very limited concept of what is involved in the study of chemical technology.

Why do so many of our students enroll in a course of study in which they do not seem to be interested? Why are they so poorly motivated? We must remember that their interest is in improved vocational opportunities, not in the pursuit of knowledge for the sake of knowledge. They are continuing their schooling because they are told on every side that it is the thing to do.

In all too many cases, the student's previous school experience has not helped him to develop serious vocational or intellectual goals and interests. High school has not really been a challenge to him. Although such students may have the mental ability to do good work, they have not been pushed beyond the point of doing just enough work to get a few B's and C's. They have not been discipline problems. They attended classes, did what was asked of them, and didn't cause trouble. All too often, their teachers did not have time to help these students develop their interests. This is not intended as a criticism of the teacher. There is only so much time in a school day. By the same token, this type of student may not have received much help from the vocational counselor. There just aren't enough counselors available. Also, in many cases, the student comes from a family where there is little interest in education, and therefore he receives little or no encouragement at home. We should not be surprised by the apparent lack of drive that we encounter so often.

Why paint such a grim picture? It is very simple. We are going to take a student from an atmosphere where academic failure is almost unknown and plunge him into a strange new world where presently 65 per cent or more of the entering students will not complete the program. It is taken for granted that he is highly motivated, but unfortunately many times this is not true. Therefore, we must keep these facts in mind when we design our curriculum and develop our teaching methods.

We must keep in mind that most, if not all, of the students are enrolled in the program for vocational reasons. Therefore, we must design our curriculum with this in mind. We must avoid the temptation to include topics that are primarily of very theoretical interest or "because they are always included in chemistry programs."

The instructor must recognize that he may have to go a little slower and into more detail than would be the case if he were teaching in a four-year curriculum. We cannot take the student's personal initiative for granted. This is not to say that the student should be "babied," but it does mean that the class probably will move at a slower pace than the instructor would like.

We recognize that our primary problem is student motivation. It is my personal belief that motivation could be developed by giving the student practical work experience before he completes the program. This would give the student an opportunity to see the applications of his training.

Finally, we may ask whether or not we are reaching the student who should be entering the chemical technology program. I do not believe that we are. As I have said before, I doubt if this student gets much attention from his vocational advisor. We can't be sure that this student takes advantage of college nights, career-day programs, and so forth. In many cases advisors and high school teachers are not aware that chemical technology programs exist. Their most likely source of information is their circle of friends. We should recognize that we need to develop recruitment programs aimed at a different set of students than those who are primarily interested in four-year programs.

The two-year chemical technology programs offer a great opportunity for many individuals to qualify for better-paying jobs and an improvement in their social status. The program equips them for employment in our rapidly changing technological society. To a large extent this program will appeal to individuals who in the past might have completed only high school. These individuals constitute a different group than those who enter four-year college programs. The difference is not primarily in mental ability, but rather in attitude, motivation, social background, and career goals.

Teaching Materials Needed for the

Recommended Curricula

by

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All of you here are familiar with the results of the ACS Technician Curriculum Committee on the development of a basic chemistry curriculum, chemistry core courses, for the training of chemical technicians. My objective is to suggest materials that may be useful for fulfillment of the guidelines. At present there are no texts written specifically for the training of chemical technicians, so we revert to the use of existing texts.

If we decide to head in this direction, we should consider how adequate the present texts are. I foresee no overwhelming difficulty in the areas of organic, analytical, and physical chemistry because there are enough classical texts available that adequately cover these subjects in a technician's training. The problem develops in general and instrumental chemistry.

In general chemistry, the first half of most texts is concerned with an abstract presentation of material. Some of the subjects are: basic atomic theory, ozone and hydrogen, the liquid state, the solid state, water and hydrogen peroxide, the electronic theory of bonding, etc. This presentation of material requires at least one semester. It is good to know that s, p, d, and f is a useful concept in chemistry, but what does a student who is industrially oriented need to know beyond the octet rule? The student usually has little interest in the material because of its abstract nature and cannot understand or work with the ideas because of their theoretical basis.

During this semester, what is the student doing in the laboratory? He is performing such experiments as weighing operations, chemical separation of a mixture, determining the formula of a compound from experimental data, determining equivalent and atomic weights, and so forth. As can be seen, the laboratory is quantitative. The student in most cases enjoys himself in the laboratory and tries to find it rewarding. He is confused and has a conflict because he cannot find a weld between lectures and laboratory. Would it be possible to interlock the abstract and quantitative material in such a way as to make the experience more rewarding to the student?

The second semester is less difficult for the student because one can orient the course toward qualitative analysis.

The student can see the problems and knows how to acquire the answer by the use of mathematics. He is grasping the practical knowledge and beginning to understand his role as a chemical technician.

The present texts in instrumental analysis are highly theoretical and very inadequate. I believe the course should be an extension of quantitative analysis and the student should be allowed to perform quantitative experiments by the use of instruments.

A second possibility is the use of paperbacks. This area, as we realize, is not well developed. Some existing paperbacks are Stoichiometry and Structure; The Mole Concept in Chemistry; Principles of Chemical Equilibrium; Acids, Bases, and the Chemistry of the Covalent Bond, etc. The paperbacks could be useful in teaching general, analytical, and organic chemistry, but to my knowledge none has been published in instrumental chemistry.

The present problem with the paperbacks is that most of them are presented in an abstract manner and the student has little opportunity to solve practical problems, which he likes best. Another difficulty is that most of them are 150 pages in length and it would be difficult to present over four topics in a course. I believe that paperbacks containing brief descriptive material as well as practical problems could be developed in 50 pages or less, which would be adequate for teaching technicians.

A third outlet is to teach all subject areas or courses from a laboratory point of view. In this case, each area of importance or course could be divided into three sections, such as pre-laboratory, laboratory, and post-laboratory.

The pre-laboratory section would be a general lecture on the area to be studied in the laboratory and an explanation of all the principles involved as well as the necessary calculations. The student would then perform the experiment.

The post-laboratory section would be concerned with an explanation of any unusual observations and the presentation of practical problems relative to the experiment. I am suggesting that a lecture and laboratory course could be developed as a unit in all major areas of importance to a chemical technician, such as basic concepts, the mole concept and stoichiometry, and others.

In conclusion, I would say that my experience with teaching in the technician field shows that the student's interests are mostly in the area where he can see the solution to a practical problem. He is not very much interested in theoretical aspects and tends to dislike too much descriptive material. He is the chemist of twenty years ago and a practical doer, not an abstract thinker.

Round Table Discussions

To facilitate exchange of ideas, round table conferences were used for discussion of three topical areas: (1) the technician in college, (2) the technician in industry, and (3) the college/industry interface. With the exception of the moderator and recorder for each discussion group, each conference attendee was given the opportunity of discussing each of the topical areas during a one-hour period. The moderator and recorder provided continuity for a topical area while three different groups discussed it.

The Technician in College

Moderator: John Kushner, Broome Technical Community College
Binghamton, New York

Recorder: Morris Lieff, Middlesex County College
Edison, New Jersey

Initial discussions concerning the prerequisites for students to enter chemical technology programs indicate requirements that range from one year of mathematics and one year of science to three years of mathematics and three years of science. Detailed discussion of the mathematics prerequisites led to some consensus that two years of college preparatory mathematics would meet the requirements of the guidelines prepared by the U. S. Office of Education and the American Chemical Society. It was felt that three years of mathematics would be preferred but that two years of algebra or one year of algebra and one year of geometry would suffice.

There is considerable disagreement regarding the requirement of a science as a prerequisite for a chemical technology program. There was some feeling that high school chemistry should be a requirement although some felt otherwise. A suggestion was made that high schools consider giving two tracks of chemistry courses, one of which would be designed for those expecting to pursue professional careers in technical areas and the other designed for students planning to pursue careers of a more applied nature. There was a consensus that high school chemistry or physics was helpful to students entering chemical technology programs but that it not necessarily need be at the college preparatory level.

Industrial representatives commented that a working knowledge of algebra and trigonometry would be sufficient for chemical technicians working in industry. They indicated that special mathematics requirements can be provided by tutorial procedures as the chemical technician performs his tasks. It was suggested that some introduction to calculus might be desirable toward the end of the student's chemical technology program. There was consensus that it was mandatory that chemical technicians have a working knowledge of algebra and trigonometry; calculus and analytical geometry are desirable but not mandatory. One state-

ment that indicates the level and characteristics of the mathematics programs that might be offered in the chemical technology curriculum is that a working knowledge of algebra and trigonometry should be developed and a cultural knowledge of calculus should be incorporated.

Appreciating that chemical technicians would spend most of their working life either in the laboratory or operating various types of equipment, one group directed its discussion toward minimal laboratory facilities for chemical technology departments. It was generally agreed that facilities should be adequate to permit chemical technology students to work alone rather than be required to form groups of two or more in order to have access to equipment.

It was felt that skills should be developed so that a student would be prepared to use the following techniques or equipment:

1. Weighing on both single- and double-pan analytical balances.
2. Volumetric analytical techniques.
3. Distillation, using both vacuum and atmospheric procedures.
4. Recrystallization.
5. All types of chromatography techniques, with emphasis on gas chromatography.
6. Synthesis techniques.
7. Spectrophotometric methods.
8. Practice of safety.
9. Recording of data.
10. Physical testing, using various facilities.
11. Electrical and electro-chemical measurements.
12. Glass blowing (there was some disagreement about this being a requirement).
13. Use of hand tools (there was some question concerning the need for this item).

It was agreed that chemical technicians should be able to perform quantitative computations in the following areas:

1. Graphical interpretation and graphing.
2. Standard stoichiometry.
3. Calculation of empirical formulas.
4. Simple kinetics.
5. Solution of algebraic equations.
6. Statistical analysis of data, including error analysis.
7. pH calculations.
8. Determination of areas under curves (there was some question concerning this).
9. Computer analysis (there were questions concerning this).

Faculty and staff members should have had industrial experience and should also have the opportunity to be exposed to industry on a regular basis. It was suggested that faculty in chemical technology be given sabbatical leaves for advanced study. It was also suggested that a reciprocal arrangement might

be made with industry to permit the faculty member to get further exposure to industrial practices and to replace him in the classroom with a regular industrial employee.

The possibility of adapting a chemical technology curriculum to satisfy local needs represents a strong point for the chemical technology curriculum. The chemistry core content recommendations by the ad hoc Technician Curriculum Committee leave adequate room for options to satisfy local needs. These needs should be determined by local advisory boards or possibly through the Education Committee of the ACS local section. It was indicated that special options are expensive in terms of laboratory equipment, and it was felt that industry should be willing to help defray these costs. It was also suggested that students who had completed the associate of science program might return to the school to take specific options.

It was suggested that sufficient option courses are in demand to stimulate the development of topical outlines in areas such as plastic technology and unit operations.

There was a consensus that a chemical technology program should be two years in length, with an intermediate summer in industry being very highly recommended. There were some suggestions that the future may require that the program be extended for a three-year period and then eventually develop into a four-year program.

The Technician in Industry

Moderator: Milton Konecky, Enjay Coatings & Intermediates
Laboratory

Linden, New Jersey

Recorder: Milton Goodman, Westchester Community College
Valhalla, New York

Addressing itself to the inherently difficult problem of defining a technician and establishing the role of the technician in industry, this round table found numerous areas for discussion but rather little agreement.

The description of the employer expectations about technician performance varied from company to company. It was suggested that chemical technicians be given starting jobs at a relatively common level of activity and that after a period of time, as the technician gains experience, he be directed to other areas best suited to his individual characteristics and skills.

It was found very difficult to establish definite parameters that would permit accurate definitions for describing technicians. It was felt that in some areas, such as medical technology, defining technicians is relatively easy because of the structuring provided by law and regulation. Since industry is not so structured, a rigid definition for a technician is difficult if not impossible to derive. A start on a good definition for chemical technicians was made through the suggestions that the wide variety of facilities available in many schools permits the development of a wide variety of skills on the part of the chemical technology graduates. This broadly based competence serves to separate the graduates of a two-year chemical technology program from technicians who have obtained their training in industry and have a much more narrow base of competence.

In view of the difficulty of defining a technician, attention was directed toward the specific skills technicians must have other than their apparent technical skills. These must include the communication skills of reading and writing, and the chemical technician should be expected to be somewhat resourceful in the application of his technical skills.

Further discussion attempted to relate the role of the chemical technology graduate to the role of the baccalaureate degree chemist in industry. A discussion of the transferability of courses in chemical technology led to no consensus since some of the attendees felt that the courses should be transferable although others felt that the transferability should not be a major criterion for the development of chemical technology curriculum.

The College/Industry Interface

Moderator: Henry Fairchild, Charles Pfizer and Company, Inc.
Brooklyn, New York

Recorder: Fred Schmitz, New York City Community College
Brooklyn, New York

Industrial advisory committees for chemical technology departments were considered useful in areas such as placement, summer jobs, and cooperative programs. There was divided opinion as to whether or not advice on curriculum content given by the advisory committees is good. It was indicated that the ACS ad hoc Technician Curriculum Committee is encouraging members of ACS to become active in the advisory committees for chemical technology programs. There was consensus that much more could be done by industry to facilitate the recruitment of students for chemical technology programs. It was also felt that this would be appropriate since the industries would benefit by being able to obtain more chemical technology graduates. It was suggested that industry sponsor and finance a film or filmstrip on chemical technician education. Dr. Carleton Roberts indicated that an audio-visual program on chemical technicians is available from Clayton Dickey, Public Relations Office, 47 Building, The Dow Chemical Co, Midland, Michigan.

It was suggested that ACS assemble a high-quality booklet on chemical technicians that could be directed to high school students, guidance counselors, and high school teachers.

A strong recommendation was made that the chemical industry, possibly through the Manufacturing Chemists Association, make available summer employment opportunities for two-year college chemical faculty. This is particularly needed for chemical technology instructors who have had little or no industrial background. It was felt that a college-industry relationship should be developed to provide continuing cooperation for the sustenance of chemical technology programs. It was suggested that any ongoing program of cooperation should include the following:

1. Summer employment programs for faculty, particularly those with little or no industrial experience.
2. Industrial involvement in the recruitment program for students in chemical technology programs.
3. Development and continuation of public relations programs to inform students, parents, and the community about opportunities for chemical technicians and the requirements for entering chemical technology programs.
4. Recognition of chemical technicians in terms of a career progression, status within the companies, and other activities designed to have the same final effect.

Cooperative work programs were discussed. It was felt that there are many administrative problems inherent in the operation of a cooperative work program. The cooperative

program was considered worthwhile by the participants, who felt that it would be much easier to arrange such programs and sustain them in smaller communities than in the large urban areas. It was felt that a more beneficial program might be a cooperative program that would involve the faculty rather than the students. This would permit faculty members to work for a period of time in industry either for a summer or on the basis of an industrial fellowship.

A Private Technical Institute Approach to Recruiting Students for Chemical Technology

by

**William Thrane
Spring Garden Institute
Philadelphia, Pennsylvania**

In meeting with high school students over several years, I have developed in my mind a typical student, whom I have named "Charley Average." As his name implies, he is an average student who in the twelfth grade has not made a firm decision regarding his educational future. When, in discussions, his father learns of Charley's mild interest in the sciences and a curiosity of things mechanical, he is directed to make application to a nearby university to study chemical engineering, an area his father considers prestigious, well paying, secure, and worthy of his budding Winston Churchill.

The college admissions officer quickly learns that although Charley did take the college preparatory subjects in high school, he was a C, or average student. He took the College Entrance Examination Board Scholastic Aptitude Tests and scored 450 in mathematics and just below that in the verbal area. His class rank is just about in the middle, and Charley is politely discouraged from continuing this particular pursuit. This fact he sadly reports to his father, indicating that it sounds like a good area of study but he didn't meet the entrance requirements. Father is sympathetic but undaunted and tells Charley of how through a series of personal contacts he can "get him in" a Midwestern liberal arts college. This is still prestigious; and, regardless of the end result, it is college.

The possibility exists that a two-year program in chemical technology may have been a good answer for Charley, but he turned his back on it as thousands of average high school graduates do each year.

There must be reasons why this happens. There must be some objections; and, if we know them, we should be able to overcome them.

The ones we hear most often are:

1. "I (or my parents) want a B.S. program." Surely each of us has been exposed to many students who have continued into baccalaureate studies in chemistry with varying degrees of credit transfer. Those who enter employment are encouraged as well as subsidized for continued degree work. Of course it may take longer under these conditions, but those students may not have been permitted one foot in a B.S. program at the time of high school graduation.

2. "I'm interested in job opportunity and advancement as well as good salary benefits." The answer here is obvious, based upon your own experiences with some of the largest corporations in America sending professional recruiters "hunting" your graduates, offering challenging positions and top salaries.

3. "I don't want to be a bottle washer." Here is a chance to turn chemical technology into a profession.

These objections are obviously easy to overcome, but they were of no value in Charley's case. Therefore, there must still be another reason for thousands of students, who might be great chemical technicians, going off in other directions. That reason is simple. Charley just didn't know anything about it. His father knew nothing about it, and his counselor and teachers probably knew very little.

There is only one way to overcome this. Tell them about it. Tell them face to face. Send statistics, reports of conferences and literature, but meet them and talk to them. And when you think they understand, tell them again.

To whom do you talk?

1. Guidance counselors, but don't ever give them credit for being knowledgeable in your area. There is no reason why they should be. Talk to them in the same way you would talk to a student. Keep in mind that you are a valuable source of information to the counselors and they need your help.

2. Science department chairmen and teachers. They are very often quite removed from the areas of industry and must be kept informed. They, too, need your help since on many occasions they are the real guidance counselors who are looked upon as professionals in their area and who may often give a misguided answer to a student only because they don't know. These people can be a strong ally and help in arranging classroom career guidance programs that your representatives can conduct during school hours, particularly in chemistry and physics classes. This brings us to the last person to talk to: the student.

3. The average students may be called the best of the worst or the worst of the best, but we should never downgrade their intelligence when talking to them. Nevertheless, we must assume that they know very little regarding chemical technology, which brings me to my next point.

What do you tell these people?

1. I think you must begin by relating chemical technology to the whole field of chemistry. Show the relationship of the various technicians to the people around them and what their particular function is in the team concept of industry, whether in research, development, production, or sales.

2. Make a profession of chemical technology. These are not hourly paid bottle washers but a vital part of a scientific team. Show just how important they are in industry.

3. Point out the situation of the demand for these people continually getting farther ahead of the supply. Some day they will go to work, and there are two ways to approach this time. They can go around knocking on doors or have the "doors come knocking on them."

4. Illustrate starting salaries of your graduates and their ability to advance.

5. Discuss the possibilities of continued education.

6. Get these average students thinking realistically. Show them that in the various areas of technical education there are three ways to teach:

- a. To develop the mind through teaching of theory.
- b. To develop the hands through skill emphasis.
- c. To combine both.

These also represent the nature of technical and scientific work. Ask students if they would someday like to work with their minds, their hands, or a combination of both "where the action is." If they can make that preliminary selection, then ask them for which they can academically qualify.

What not to say:

Avoid stressing admission requirements, curriculum discussion, and particularly scientific terminology when talking to a group of probably uninformed students. These items should come up in the form of answers to questions raised by students who by now have heard enough to want to know details.

All these things perhaps sound good but do they work? Our school is very small; and historically, as in most schools offering chemical technology, this has always been our smallest department with respect to number of students. Three years ago we had a freshman chemical technology class of five. Following the aforementioned suggestions we had over thirty freshmen the next year. Thinking that everyone concerned now knew everything about chemical technology, we began concentrating on other areas with a very self-satisfied attitude. The following year the freshman class in chemical technology consisted of two.

College Recruitment Problems and Programs

A Public Community College Approach

by

Carmelo Greco

**Consultant, Division of Technical Colleges
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My topic is a public community college approach to the recruitment problem. But before I speak to the topic, a little orientation may be in order. (1) Connecticut has four state technical colleges. (2) These are wholly state operated. (3) They are actually area technical community colleges. (4) All are degree programs and are designed to prepare chemical technicians. All are ECPD accredited. (5) Until July 1 they were state technical institutes. (6) This explains the reference to technical institutes in my talk. These schools are now the state technical colleges.

What do we know about the chemical industry? What does the common man, the average parent know about the industry? What does the average or even better-than-average high school student know about the chemical field other than the unpleasant odors in and around the chemistry laboratories? There is lack of what might be called chemistry consciousness.

Things mechanical and electrical are in our homes and all around us. From early childhood, we start tinkering with the bicycle, the radio, the TV set, the automobile. We see construction going on and surveyors peering through long tubes. We are closely involved; and this develops an awareness of the mechanical, electrical, and construction fields. How many of us come so intimately in contact with chemistry? Yet the chemical industry touches directly or indirectly every phase of our lives. Most of the basic things of modern living could not exist without the chemical industry. And who would pay for our radio and TV programs if there were no soaps and detergents?

The chemical industry in the United States accounts for 7.5 per cent of all manufacturing shipments, 18 per cent of the gross national product, and 20 per cent of all industry-financed research and development, according to the Manufacturing Chemists Association.

Manufacturing, research, and development require team effort--scientists, engineers, technicians, and craftsmen working together to produce new products which, the chemical industry predicts, will account for three-fourths of its business by 1975.

Technicians are relative newcomers on this team. They fill a wide range of positions from installation, testing, and maintenance to work as assistants in advanced research projects. The range is so great that it is difficult for those of us who produce technicians to define them specifically, and the employer who is making full use of their capabilities is rare.

The name scientist, engineer, tradesman, each has some meaning, recognized by the general public. The name technician still is nebulous. Couple this with lack of knowledge of the chemical industry and the lack of a chemical consciousness or awareness. The result is the recruitment problem we are experiencing.

What can be done about it? I wish I could say we had found the answer in Connecticut. But we, too, have a recruitment problem in chemistry. The problem is quite complex. I have mentioned only two of its main ingredients. However, I believe the solution of these two parts will reduce the recruitment problem in chemistry to the same dimensions as the recruitment problem in the more popular technologies.

The solution requires the best efforts of the two great partners who are participating in this conference--industry and education (in this case, the chemical industries). Both have a big stake in the solution of the recruitment problem. Technical education serves people and industry. Both can be served better if their needs are known. If industry lets the schools and the people know its needs, the schools will develop the programs (as we have been doing at the curriculum discussion of this conference), and the students will enroll in these programs.

Let us look at a case study of industry-education cooperation. From 1946 to 1960, Connecticut had one small technical institute in Hartford, enrolling about 160 students in electrical, mechanical, and tool technology. In 1960 this institute went into new quarters built to house 350 students, and civil technology was added to the program. Meanwhile the legislature had appropriated funds to build three additional institutes. State Department of Education studies conducted to justify this expansion indicated, among other findings, an estimated annual need for 125 chemical technicians in the decade 1963-1973.

These three additional institutes opened in quick succession: Norwalk in 1961, Norwich, 1963, and Waterbury, 1964. Needless to say, each of these institutes offered chemical technology. Each of these institutes failed to get an enrollment of thirty-five in chemical technology in spite of the need for chemical technicians.

As director of the Waterbury Institute, your speaker pointed out this fact to his chemical technology advisory committee in 1964 and stated the need for industry-institute cooperation. The seed fell on fertile soil.

In January, 1964, the chemical industries in Connecticut had formed a Chemical Industry Council (CIC). This council had decided on education as one of its major areas of activity. A member of the Waterbury Institute Advisory Committee was also a member of the CIC. The seed of industry-institute cooperation began to germinate and flourish.

The CIC's objective was clear. The employment opportunities begged! The necessary education facilities were available! The awareness was lacking! The CIC turned the job over to its chairman of educational activities. Things started to move. Considerable communication by letter and telephone ensued between CIC members, the chemical industry, and education to develop ideas and suggestions as to courses of action.

A dinner meeting in January (timing is important) was agreed upon. The objectives were:

1. To develop an awareness of the opportunities for chemical technicians.
2. To acquaint high school students, educators, and the general public with the nature of technical institutes and the job opportunities for graduates.
3. To encourage industry, and especially the chemical industry, to make more effective use of institute graduates and to provide motivation for students to enter the field.
4. To show how close industry-education cooperation can lead to potential mutual benefits.

A program of action was developed. Members of CIC and education were given specific assignments, such as: contacting selected speakers, drafting letters of invitation, preparing press releases, preparing guest lists, etc., and establishing time schedules. A popular United States senator who had been state governor was invited as main speaker. The CIC chairman and education chairman acted as a coordinating team, with the education chairman devoting most of his working day and much of his sleeping time to the project. A detailed letter explaining the project, the cost, and containing a bill for each plant's prorated share was sent to all CIC members by their chairman.

Letters were mailed to educators thirty days before the event. The state commissioner of education wrote to high school principals and superintendents. The state consultant for guidance services wrote to city directors of guidance and head guidance counselors. The state consultant in mathematics and science wrote to the heads of the respective departments in high schools. The CIC sent letters and invitations to key

industrial personnel. A detailed press release was sent out early in January to local, state, and selected national communications media, including radio and TV. Personal follow-up with key media personnel was accomplished via prearranged assignment.

Engraved invitations were printed by students in the printing trade in one of the state vocational schools and sent to all invited guests. A buffet supper was planned, prepared, and catered by food and restaurant management students of a state vocational school and served in the Norwalk State Technical College cafeteria. Selected students were assigned as hosts in each classroom. Other students acted as receptionists, checkroom clerks, guides, and messengers. Students performed and explained experiments in the laboratories, where the name and function of each piece of major equipment was given on cards.

Provisions were made to locate press services centrally, near telephones, on the meeting day. Press kits were prepared containing:

1. Information about the chemical industry and CIC, the technical institutes, and the institute graduates and their opportunities.
2. Statements from present students and graduates.
3. Photographs and captions.
4. Copies of speeches.
5. Biographical information and photos of speakers and key persons.

The program included a tour of the institute from 4-5:00 p.m. and talks by the general chairman and education chairman of CIC, an industry representative, and the state director of vocational education. These were followed by a buffet supper and talks by the state commissioner of education and Senator Abraham Ribicoff. Afterwards there were informal discussions and additional tours of the facilities.

According to CIC, the cost for the entire project was nominal. Actual cash outlay was restricted to postage, minor transportation, and out-of-pocket cost for food paid only by industry representatives. Everything was free for all other guests.

Over 550 guests from government, industry, education, and the news media participated. The over-all result was a tremendous enthusiasm among all present; wide news media coverage that brought the message to the general public, the parents, and the students; and a better understanding of the technical institutes by industry and the education community. One guidance counselor remarked, "We probably would not have had the opportunity to see these wonderful facilities and learn about the program firsthand but for this meeting." Another wrote, "We are grateful to you for planning such an outstanding program, and wish to

assure you that we will find it extremely helpful as we help our students plan for their future education careers."

The stated objectives were certainly realized. Enrollment of chemical technology freshmen in 1965 increased 59 per cent over the 1964 enrollment. Our 1966 and 1967 chemical technology enrollments, however, are only 13 per cent better than those in 1964 in spite of the addition of student personnel directors in all four technical colleges. It takes more than one big event to bring about behavioral changes. It takes continued effort. We must tell the story over and over again and in many different ways.

This case study shows one way. It was told here because I believe it contains the elements necessary for successful recruitment. These include:

1. Close industry-education cooperation and understanding of each other's roles and needs.
2. An energetic, imaginative, public relations program. This is the key lack in educational institutions.
3. Participation by personnel from whom reaction is wanted, in this case, key high school and industry personnel.

As a result of this meeting, for instance:

- a. News broadcasts highlighted the senator's speech on all major Connecticut radio and TV stations.
 - b. Two editorials cited the institutes on Channel 8 TV.
 - c. A half-hour presentation entitled "Your Community" was given on Channel 3 TV. Another presentation on Channel 8 entitled "Comments and People" was given, on which were seen the commissioner of education and a U. S. Office of Education representative as interviewed at the meeting, and a film showing the institute tour.
 - d. Participants were the commissioner of education, a chemical industry representative, and a chemical technology girl student. (We want to attract girls.)
 - e. The meeting was also the subject of a major feature on the front page of the business and finance section of the New York Times and in the Washington Post.
 - f. There were also feature articles in four industry periodicals.
4. News value or newsworthiness. It is necessary to have newsworthy persons or events that can serve as vehicles for the story to be told. This, plus hard work by the PR man, will ensure wide coverage by newspapers, periodicals, radio, and TV and will promote follow-up.

The meeting generated a tremendous amount of publicity before and after the event. This publicity reached those we serve--the general public, the parents, the students, and industry. It generated enthusiasm among high school principals,

guidance counselors, and industry representatives through participation in the event. It created an awareness among all concerned, resulting in increased enrollment.

The case study also proves that a single endeavor is not sufficient; the effort must be continuous. It proves that bringing about change in behavior is considerably more difficult than just disseminating information through letters, folders, catalogs, visitations, and the usual media that schools employ.

We must continue to do all this, but we must do more. We must tool up to design programs and make the necessary effort to have those whom we wish to influence more operationally involved. Increased participation in good programs creates positive attitudes. We need conferences, courses, demonstrations, and workshops that will involve high school mathematics and science teachers and counselors and get them into our schools. We must design programs for parents and high school students. We must work closely with industry, and industry also must tool up to develop an awareness of chemistry.

Together we can do the job.

The Recruiting Problem from Other Vantage Points

A Panel Discussion

Moderator: Lewis Fibel, American Association of Junior Colleges
Washington, D.C.

1. Remarks by Donald Allen, Thames Valley State Technical College
Norwich, Connecticut

The major problem of recruiting students is informing prospective students of the potential of the two-year program in chemical technology. Many students are virtually compelled by their families to start a program of study in a four-year college. Those who are refused admission to the program of their choice in four-year "prestige" colleges will frequently seek admission to a liberal arts college that will give them a four-year degree in something or other. Thus, many potential students are lost to the two-year technology programs because of the prestige given by society to the four-year college programs regardless of the interests of the student or the usefulness of the college program.

Naturally, we must acknowledge that the four-year bachelor of science degree in chemistry holds more prestige than does the two-year degree in chemical technology. It also leads to better earning power, a better chance for more challenging work, the opportunity of attaining more authoritative positions, and more autonomy in planning for future work. Since everything is in favor of the four-year degree over the two-year degree, the best of students who graduate from high school begin a collegiate education in four-year institutions. The technology programs are then left with part of the second quarter and a few in the first, third, and fourth quarters of the high school graduating classes.

The competition with four-year colleges for the acquisition of students is increasing. Many more openings are being made available in four-year colleges for students in the lower economic strata of our society. In recent years, many more scholarships and grants-in-aid have been made available to college students. The rapid increase in the numbers of state colleges and the rapid expansion of their enrollment provide many more openings for students who otherwise might have considered a two-year technical program. Thus, two-year programs may be able to attract only students who have very restricted interests in the sciences, those who do not have the financial means to stay in a four-year college for the four years, and those who have no desire to go to a four-year college in the first place.

In looking at the specific problem of why recruitment is so difficult for chemical technology programs, we must look at some of the competition since the advent of the Sputniks in the

late 1950's. There has been a tremendous emphasis placed upon electrical engineering, computer development, and utilization of all types of automated controls. Thus, much attention has been directed toward electronics and associated areas at the expense of the chemical area.

When recruiting for the chemical technology programs in Connecticut, we emphasize the fact that the chemical industry is the fastest growing industry in Connecticut. We also emphasize the stability of the chemical industry, which is concerned with the development and production of many items that are not strongly dependent upon a current economic situation. Some of these stable areas include pharmaceuticals, gasoline, petroleum products, and plastics. There is relatively little dependence of the chemical industry on sales to the federal government. In many other industrial areas, there is a feast or famine situation that depends upon the economic situation at a particular time or upon world affairs. Thus, when a student appears undecided about what technology area he should consider, we emphasize that although other programs may receive initially higher pay, the chemical graduate may well have the better earning situation over a long period of time.

Thames Valley Technical Institute is using a pre-technical preparatory program that is presently enrolling about 56 to 58 students. These students have minimum qualifications, get into the institute, and have consented to take this preparatory program, which emphasizes mathematics, physics, some electricity, and English. These are borderline students who have agreed to spend three years to obtain their associate degree rather than two years.

Most of the students in the preparatory program do not know what technical program they wish to enter. A guidance officer is working very closely with the students. He is amazed that if a student is asked "What is the degree program for which you are preparing?" he is not ready with an answer. Most frequently he will reply "electrical" but with no real conviction. Representatives of the degree-granting departments talk with these students. It has been noted that few of the students have ever considered entering the chemical technology program.

When working with these pre-technical students we emphasize the stability of the chemical industry and try to portray the chemical industry as well as possible in a graphical sense. We have no films to show them, but we may well try to make use of the slide-tape program available from The Dow Chemical Co. We try to emphasize that a bad experience in a high school chemistry course, such as being forced to memorize the periodic table and the valences of all its elements, should not cause the chemical technology program to be eliminated from their consideration. We also acquaint these students with the fact that about

one third of our students continue their education in colleges and universities to obtain a bachelor of science degree in engineering or chemistry, with most preferring the engineering program.

Program preference polls of the students are taken. In the latest poll there was an increase of 45 per cent during a six-week period of students expressing an interest in chemistry. At the present time this amounts to ten students out of a total of fifty-eight.

In closing, one fact should be reiterated. It is necessary to approach the potential student and sell him on the potential of the chemical technology program. Guidance counselors, members of the peer group, and the prestige factors of the program all contribute to make the counseling job more difficult. It is emphasized that the student must be interested in chemistry if the chemical technology faculty is to be interested in him. A truthful presentation must be made to these prospective students since it is impossible to fool them even though they may not be in the upper quarter of their graduating classes.

2. Remarks by Robert Hofstader, Esso Research and Engineering Company
Linden, New Jersey

It is necessary to eliminate the word "sell" and change it to "educate" when careers are discussed. It seems that attention is directed toward the types of colleges and students' position in their high school classes, but the real issue of a career is avoided. The issue is really what the high school graduates are going to contribute to society as individuals, whether they study to be medical doctors, laboratory technicians, or typists. In particular, the companies want to know in what way the individual can contribute to their activities.

The Esso Research and Engineering Company has set up a retraining program for some of the laboratory technicians. This was needed because technology has moved forward a tremendous amount since these laboratory technicians joined the company. Thus, these laboratory technicians were simply falling behind in terms of newer technologies that have been developing. This stimulated greater interest in the training of laboratory technicians, their availability, and all of the attendant problems of the need for good laboratory technicians.

Two area schools having chemical technology programs are in the immediate area of Esso at Linden, New Jersey. These are Union County Technical Institute and Middlesex County College. In the spring of 1967 these schools issued invitations for participation in a program to inform guidance counselors and students about the technology programs and the facilities used in the educational programs.

It was very alarming to find that only five or six students out of the many that attended were interested in hearing something about chemical technology. Finding this extremely disturbing, three companies got together: Union Carbide Corporation, Merck and Company, and Esso Research and Engineering Company. It was agreed that the first thing that needed to be done was to determine why guidance counselors were not interested in the chemical technology program.

Discussions with guidance counselors indicated that it might be desirable for the industries to run a meeting on guidance. It was felt that the schools tend to sell the program, and this tends automatically to prejudice the opinions of the potential customers. It was felt necessary to avoid defending the needs or the curriculum of a school.

For this program, invitations were issued to guidance counselors from both Union and Middlesex Counties in the public, parochial, and private schools. There was almost 100 per cent response to the invitations from the guidance counselors who wanted to attend. About 130 guidance counselors attended the October 19 program at the Esso Research and Engineering Company facilities. The program was begun at 3 o'clock, continued through dinner, and ended about 9:00 p.m.

In conducting this program, members of the various companies participated in discussions with the guidance counselors to describe the need and opportunities. An industrial point of view rather than a college's was used. Emphasis was given to the requirements of the kinds of young people that should do well as chemical laboratory technicians.

Other guests at the meeting represented the New Jersey Research and Development Council, the state commissioner of higher education for the state of New Jersey, and the American Chemical Society.

After several short talks, the attendees were divided into two groups of twelve and placed in separate conference rooms. Each group included a laboratory technician and a professional employee from one of the three participating companies. The laboratory technicians gave a synopsis of their duties and activities and described their career as they saw it. The guidance counselors were very candid as they obtained information and discussed their particular problems regarding counseling and guidance. The group sessions were limited to one hour and fifteen minutes; then the groups reassembled to hear presentations from the local school presidents. One of the guidance counselors summed up the counselors' problems by saying, "I think there is one thing that has to be invented to solve this problem as well as other problems. It is a pill, not THE PILL we always hear about, but a pill that a woman takes when she first decides that she is going to give birth to a child; and this pill will disperse and give instant algebra

to the child; and suddenly he will be an acceptable member of society right up the academic line."

A better dialogue needs to be established between the guidance counselors and the area of chemistry. One guidance counselor said, "The kid who likes the chemistry that we give in high schools today should be the one who is going on to college because this is one of the courses that we use as a dividing point." The question that arises here is "Why doesn't the high school give two chemistry courses, one of which would be very laboratory oriented?" The problem then arises regarding who will be counseled into the laboratory-oriented course.

The other side of the coin is presented by the two-year college people, who state that they will not accept those who have not had academic physics and chemistry, which serve as prerequisites for their chemical technology program.

It is hoped that a meeting can be arranged to confront the guidance counselors and the two-year college people to see if some common ground can be established.

It may be possible to truly define a career, define the level of the career, and realistically define the minimum requirements. Students may not really need to know some of the things that are being given in the two-year curricula today to become good laboratory technicians. However, improving communications between industry, guidance counselors, the colleges, and even the students would help us solve some of the problems that we have today.

3. Remarks by Harvey Russell, American Cyanamid Company
Wayne, New Jersey, and
Representative for the Manufacturing Chemists Association

The Manufacturing Chemists Association is composed of about two hundred firms that make and sell chemicals in the United States. The association has about thirty functioning committees, which handle such matters as tariffs, safety technical standards, and public relations. Since 1956 or 1957 an Education Committee has operated, which consists of about twenty-five members, each of which is a representative of his own firm. The present chairman of the Education Committee of MCA is John Howard, who is secretary to the Committee for Professional Training of the American Chemical Society.

The Education Committee has two series of programs. One is a series of awards that have gained considerable stature over the past ten years for the college teachers of chemistry. One award has been given to Mr. William T. Mooney, Jr., who is known for his extremely fine work in two-year colleges. A series of awards for high school teachers is now being instituted.

The Manufacturing Chemists Association recently published a booklet entitled "A Bright Future for You As a Chemical Technician." It was developed as a result of a study by some of the members of MCA on the need of technicians and the kinds of jobs that they are expected to fill. Another publication of interest is "Education Publications Available from the Chemical Industry." This is a list of publications available from several chemical firms in various fields. There is a film guide that lists films made available through MCA. Another useful pamphlet is "Sources of Career Information in Scientific Fields." All of these are available from Dr. William Chace, Education Secretary, Manufacturing Chemists Association, 1825 Connecticut Avenue, Washington, D.C. 20009.

4. General Discussion and Specific Student Recruitment Techniques

(The following represents summaries of remarks made by individuals and does not necessarily imply consensus on the part of the conference attendees.)

1. Comparing Two-Year and Four-Year College Graduates

A comparison of the earning power of four-year graduates with that of two-year graduates requires careful analysis. When comparison is made on the basis of graduates of four-year colleges and graduates of two-year technology programs, it is undoubtedly true that the four-year college graduate has a greater earning power in terms of dollar income. However, if a four-year college graduate enjoys science and working in the laboratory and has not graduated from a rigorous program in a very good four-year college or has not continued to a master's or doctorate program, he will probably accept a job on the technician's level. This means that the individual's earning power has not increased and his lifetime earnings may have been reduced since he will not have been working for two of the years when he was in school that he would have had available had he taken a chemical technology program. It is commonplace to find that these four-year college graduates are rather unhappy. They find they are doing the same work as two-year technology graduates and therefore develop attitudes that decrease their relative earning power.

It was pointed out that many chemical technology program graduates continue directly to obtain the baccalaureate degrees. At Thames Valley Technical Institute apparently one-third of the students continue toward four-year programs. Students with grades of C or less or those having poor attitudes would not be recommended for continuation. Technology students are frequently told, usually indirectly, or sometimes directly, that to advance to more responsible jobs having higher salaries they would need to continue their education, and this means continuation to obtain more advanced degrees. The technology

graduates know that a baccalaureate is somewhat superior to an associate degree and should increase their earning power. Thus, many will continue their education to obtain a baccalaureate degree either full time or in the evening under sponsorship of the company. The two-year graduate may find his earning power considerably enhanced if he happens to be employed by a small company in the manufacturing part of its operations. There he becomes a production foreman or a plant superintendent, where much depends upon his native merit as well as the superficial coating of science that he received in the two-year college.

Industry appears to want substantial numbers of the chemical technology graduates who have laboratory skills that may be rated at the A level. Their programs should not necessarily be transferable for pursuit of a professional program in chemistry. The fact that these well-qualified technicians frequently do not enter industry but that the poorer graduates immediately seek industrial jobs may have a harmful effect on the prestige of chemical technicians generally.

2. Joint Responsibilities in Recruitment

It is both unfair and unrealistic to try to put the burden of career guidance on any one group. Guidance counselors, the collegiate-level educators, and industry must cooperate in a three-way articulation process in order to provide a realistic guidance program. One may ask if industry is doing its share if it hires a technician and advances him as he does a good job, fires him if he is incompetent, or simply holds him at a given level and provides no progression beyond that. It may be asked if the technical schools have done their job if they recruit students by emphasizing that the better performers in the technology program will be able to transfer conveniently to pursue a baccalaureate program and that those who do not perform well will be able to go into industry as laboratory technicians. Thus, two-year college personnel have sometimes been unrealistic in their design of programs, and industry has failed to develop a career potential that proves attractive to prospective students.

3. Studies Examining Influences on Career Decisions

It is important to know the factors that influence career decisions. Some work has been done on this at Harvard University and other places. The actual factors that influence young people in making career decisions are difficult to evaluate in terms of people who are important in influencing career decisions. It appears that the student's mother is the most important individual. Fathers apparently are rather far down the list. High school teachers are much more important in influencing students' career choices than high school counselors.

At the Connecticut technical schools, it appears that the guidance counselors are the most important influence on career decisions, and friends or members of the peer group are the second in importance.

4. Rigidity in the Chemical-Technology Programs

Physical chemistry and calculus seem rather unnecessary for the chemical technician. Certainly, this material is required in the professional programs, but possibly one of the difficulties of getting students interested in chemical technology is the fact that many of the programs include calculus and physical chemistry, which prove rather difficult to the type of students attracted to technical institutes. There is some feeling that requiring students to take physical chemistry and calculus places unnecessary rigidity on the chemical technology program.

There appears to be belief on the part of some of the industrial representatives that considerable flexibility in the chemical technology program would not be detrimental to providing good chemical technicians for industry. Thus, several different levels of mathematics might be available to students, based upon the students' qualifications rather than on the requirements of the degree program. The same thing is true of something like physical chemistry, which may be within the capability of some of the chemical technology students and not within the capability of many of the other chemical technology students.

If this were done, flexibility would have to exist all the way through the college's program and into industry. The industrial employers would have to be flexible through the jobs they wish to assign the chemical technicians.

5. The New Jersey Research and Development Council Program

The New Jersey Research and Development Council has established a program called "Project Technician." The council has prepared a slide library. It has developed a one-half hour television program that has been used on the educational television channel in New Jersey. It has also awarded scholarships to high school students who wish to pursue a chemical technology education.

6. Opportunities for Chemical Technicians Outside of the Laboratory

Scientists and engineers at the baccalaureate degree level are somewhat improperly educated for handling many of the jobs in production. The person who is in charge of blending, milling, formulations, grinding, and other production tasks needs to be a personnel, public relations, and sales person as well as a

good disciplinarian. Thus, many of the production chemists' jobs may be done as well or better by chemical technology graduates than by graduate chemists and engineers.

This exceptional opportunity may prove to be a beneficial one to emphasize when career opportunities are discussed with high school teachers, guidance counselors, and students. Individuals working in the production area would probably not be working next to doctorate degree level scientists but would have a very responsible position.

There seems to be a general trend for industry to look at technicians with broader concepts than has been true in the past. There is still considerable difficulty in defining the role and educational requirements of technicians. These have frequently ranged from a dishwasher to NMR apparatus operators, the education of which ranges from that of high school dropouts to that of graduate school products.

7. Use of Industrial Representatives in the Recruitment Program

There is little difficulty for parents and students to relate to what nurses do or to what accountants do, but they find it very difficult to relate to what chemical technicians do. One means of correcting the situation might be to provide a college representative and industry representative team for the discussion of opportunities in the chemical industry for chemical technicians.

Chemical industry councils, which are state or regional organizations, may be able to provide information and speakers for such activities.

There is some feeling that an MCA speaker may talk basically from an industrial viewpoint whereas ACS speakers may talk from a scientific knowledge viewpoint.

8. Use of Students in the Chemical Technology Program

Reference was made to programs having a good year of student recruitment and then having a bad year, or several poor years in succession. It would seem that the best recruiters would be students in the chemical technology program who felt that they were getting a good education that was going to be beneficial to them. One must ask if this is obtained when a high percentage of the class are falling below some set academic standard and only 50 per cent of the entering students find it possible to complete the program. Possibly, better evaluations of the chemical technology programs and more careful implementation of the curricula in the colleges could lead to a greater amount of student enthusiasm for the chemical technology programs.

Appendix A
Enrollment Profile in Chemical Technology
for Fourteen Colleges

by

Kenneth Chapman
American Chemical Society
Washington, D.C.

Fourteen of the institutions represented at the New York Conference on Chemical Technicians provided information regarding student enrollment, graduates, and continuing education. Two of these institutions offered a chemical technology program for the first time in 1967 and had no data to contribute. Of the fourteen institutions, three were located in Connecticut, four in Massachusetts, two in New Jersey, four in New York, and one in Pennsylvania.

In these institutions, the chemical technology program has a rather short history. Eight programs have been established since 1963, and only three programs had existed prior to 1953. As expected, this is reflected in the enrollment statistics.

Most chemical technology programs have from 20 to 30 new students each year. Of the institutions included in this group, only one has been admitting as many as 75 to 85 students per year for the past several years. This is a reduction from 95 to 105 new students per year from 1957 through 1961 for that institution.

Only two institutions indicated a significant number of part-time students, and these are enrolled in evening school programs. It is interesting to note the considerable increase in the part-time enrollment of these colleges. (Data for total enrollment only were provided for the part-time students.)

During the ten-year period from 1957 to 1967, the total annual enrollment in chemical technology increased from 331 to 617 students, or 86.5 per cent. These increases are caused by the establishment of new programs that draw upon a previously untapped source of students. Once established, most programs have tended to maintain a relatively constant enrollment or suffer a declining enrollment. The causes of the lack of growth in a given chemical technology program may be suggested, but their relative importance cannot be ascertained. Some potential causes are:

1. Decreasing interest of students in science or engineering as a field of study.
2. Ability to communicate with the portion of students who fail to recognize chemistry as an area of study for which they qualify.
3. Increased availability of baccalaureate programs for which potential chemical technologists have the necessary prerequisites and abilities.
4. Adverse publicity about technician opportunity that may discourage potential students.

Many other potential causes may be listed, some of which may be peculiar to a specific college.

In the 1957-1967 period, the number of chemical technology graduates per year in these schools increased from 41 to 134 or 226 per cent. This increase

cannot be directly compared to the increase in enrollment in the same period since several of the new programs have not produced graduates. The proportion of entering students who graduate averages about 49 per cent. For one institution, the proportion of students graduating varied from 29 per cent to 70 per cent during this period. Most of these colleges appear to graduate about 38 to 45 per cent of the entering class, with sufficient high exceptions to raise the average to 49 per cent.

It appears that a decreasing proportion of the graduates are being employed as full-time chemical technicians and more are continuing their education on a full-time basis.

These statistics raise some challenging questions that must be considered as curriculum development and student recruitment programs are planned. Among these questions are:

1. What factors are preventing increasing enrollments of chemical technology students in individual programs when the demand for graduates continues to rise? How do the rising educational expectation of the population, more careful screening of new students, and changing Selective Service pattern relate to this?
2. Why are part-time evening programs not more widely used?
3. What are the causes of the increasing likelihood that a graduate will continue his education on a full-time basis rather than accept full-time employment as a chemical technician? Is this trend desirable for the college offering the chemical technology program, the students entering the program, and the potential employers? Does it indicate a need for reevaluation of entrance requirements and curriculum content?

It is hoped that these questions can be considered at future conferences and meetings.

**Enrollment and Graduates Data
(Fourteen Colleges)**

No. of Students Year	New		Total		Total Grads	Continuing**		Grads. employed as F. T. Chem. Tech.
	F. T.*	P. T.*	F. T.*	P. T.*		Chem.	Other	
57-58	134		301	30	41	5	5	32
58-59	136		324	33	39	10	4	26
59-60	152		316	37	60	11	7	43
60-61	152		323	41	69	15	3	53
61-62	173		325	47	72	25	7	53
62-63	151		259	66	68	19	7	48
63-64	153		251	72	58	13	4	40
64-65	279		483	91	87	27	10	50
65-66	289		523	106	118	40	14	70
66-67	270	1	491	126	134	34	11	73

*F. T. = full-time and P. T. = part-time.

**Total number of students leaving the chemical technology program and continuing toward a baccalaureate degree in chemistry and closely related fields or in a different field.

Note: It must be recognized that one institution has produced 45 per cent of the total graduates during the period 1957-1967. In 1966-1967 it accounted for 24 per cent of the graduates.

Appendix B

Conference Attendees

Allen, Donald E.	Thames Valley State Technical College
Ayer, Howard	Franklin Institute of Boston
Babnis, Patricia	Bronx Community College
Barker, Demir A.	Orange County Community College
Bassin, Milton	New York City Community College
Boos, Richard	Merck Sharp & Dohme Research Laboratories
Bremen, Arthur	New York City Community College
Brooking, Walter J.	U. S. Office of Education
Brown, James L.	Corning Community College
Chapman, Kenneth	American Chemical Society
Ellis, Samuel B.	Dutchess Community College
Fairchild, Henry	Charles Pfizer and Co., Inc.
Fallwell, William F.	<u>Chemical & Engineering News</u>
Fibel, Lewis R.	American Association of Junior Colleges
Goodman, Milton G.	Westchester Community College
Gray, Lawrence E.	Bureau of Two-Year College Programs, New York State Education Dept.
Greco, Carmelo	Division of State Technical Colleges, Connecticut
Haas, Charles G.	The Pennsylvania State University
Haskins, James W., Jr.	<u>Chemical & Engineering News</u>
Helmprecht, Hans L.	Farmingdale Agricultural and Technical College
Hofstader, Robert	Esso Research and Engineering Company
Konecky, Milton	Enjay Coatings and Intermediates Laboratory
Kushner, John	Broome County Technical Community College
Lamprey, Philip S.	Lowell Technological Institute

Leonard, Harold

Lieff, Morris

Maresco, Anthony

Munnelly, Kevin

Pfister, William

Porter, William

Roberts, Carleton

Russell, Harvey

Samuels, William P., Jr.

Schoenberg, Samuel

Schmitz, Fred

Swanson, Donald L.

Thrane, William

Tyler, John E., Jr.

Wagner, Anne M.

Wagner, Gerald R.

Wikstrand, W. Carl

Auburn Community College

Middlesex County College

Suffolk County Community College

Charles Pfizer and Co., Inc.

Farmingdale Agricultural and Technical College

Temple University Technical Institute

The Dow Chemical Co.

American Cyanamid Company and
Manufacturing Chemists Association

Union Carbide Corporation

Board of Education, Brooklyn, New York

New York City Community College

American Cyanamid Company

Spring Garden Institute

Holyoke Community College

Onondaga Community College

Erie County Technical Institute

American Cyanamid Company